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A Threat to Intensive Management of Ponderosa Pine in the Rocky Mountain Area and Southwest

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Rocky Mountain Forest and
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Fort Collins, Colorado 80521

Abstract

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Western Pine-Shoot Borer:
A Threat to Intensive Management of Ponderosa Pine in the Rocky Mountain Area and Southwest

The western pine-shoot borer, *Eucosma sonomana* Kearfott (Lepidoptera:Olethreutidae), is attracting increased attention in the western United States as a pest of ponderosa pine, *Pinus ponderosa* Laws. The insect attacks new pine shoots, deforming leaders and reducing height growth. Stoszek (1973) described severe damage to plantations in southeastern Oregon.

We have found infestations of *E. sonomana* near Chevelon, Coconino County, Ariz.; Jemez Springs, Sandoval County, N.M.; and Pagosa Springs, Archuleta County, Colo. A more recent trapping study, still unpublished, indicates that *E. sonomana* is widely distributed throughout the entire western U.S., and we expect it will become increasingly recognized as an important pest wherever intensive forestry is practiced. The purpose of this report is to alert Rocky Mountain area and southwestern foresters to the insect, the damage it causes, and current thinking about how to minimize losses from it.

Life History, Habits and Damage[2]

E. sonomana is a small moth that has a typical moth life history — eggs, larvae (caterpillars), a pupa or resting stage, and finally the adult insect, the moth. Activity begins in early spring when newly emerged moths mate and lay eggs on fresh pine terminals at the time the shoots are elongating. The eggs hatch within a few days. The larvae enter the leaders near the terminal buds and make their way directly to the pith, where they begin mining downward. Generally there is only one insect per shoot and, particularly in young trees, only the leader is attacked. When larval development is completed, around midsummer, the larva chews an exit hole in the lower part of the shoot and moves — at least in small trees — to the ground to build a cocoon, pupate, and overwinter in the litter. Details of the pupation site, particularly in larger trees, are scant.

The effect of larval feeding on the shoot is variable, depending on the success of the larva. The extremes are instances in which (1) the larva dies soon after entering the shoot, causing little or no damage, and (2) the larva mines the shoot so completely that the shoot dies. The damage is often somewhere between these extremes, with the

[2]*Some of the material in this section is taken from a paper entitled "Biology and control of the western pine shoot borer" presented by S. C. Cade, T. W. Koerber, and K. J. Stoszek at the annual meeting of the Entomological Society of America, Honolulu, November 28-December 2, 1976.*

larva successfully completing its development and the shoot continuing to live but being stunted. This leads to the characteristic "shaving brush" kind of leader shown in figure 1. The shoot and needles are shortened and the needle bundles are more closely spaced than normal, giving the foliage a typically dense appearance. There is usually no needle fading, nor — in ponderosa pine — any tendency of the leader to droop. This contrasts with Grant's (1958) report on *E. sonomana* in lodgepole pine, *P. contorta* Dougl., in which infested leaders are said to droop. Often the leader is not only stunted, but is also overtopped by one of the laterals. If the lateral assumes dominance, a crook or a fork results.

For 3 years, starting in 1974, we looked closely at examples of damage in 20 young trees growing near the Turkey Springs Guard Station, some 7 miles (11.3 km) northwest of Pagosa Springs, Colo., at an elevation of about 7,600 feet (2,316 m). Our main objective was to get a general picture of damage characteristics as evidenced by (1) incidence of annual attacks on individual trees, (2) effect of attack on the leader, and (3) leader replacement by uninfested laterals. The stand at Turkey Springs is pure ponderosa pine with a scattered overstory of large trees, diameter around 24 inches (61 cm) at breast height, and an understory of dense natural regeneration about 20 years old, and about 8 feet (2.4 m) tall, growing in clumps (fig. 2). We examined these young trees and chose 20 with infested terminals. We measured tree height to base of the 1974 growth, and length of the infested leaders and longest 1974 laterals. Observa-

Figure 1.—Growth of ponderosa pine leader on left has been reduced due to infestation by western pine-shoot borer.

Figure 2.—Ponderosa pine stand at Pagosa Springs, Colorado. Dense natural regeneration is infested with western pine-shoot borer.

tions were made July 16, 1974, July 24, 1975, and October 18, 1976, all after the current year's infestation had taken place.

Figure 3 shows the 3-year infestation pattern for the 20 trees. Although the pattern of annual attacks may not be well represented by such a small sample, 5 of the 20 trees infested in 1974 were hit again in 1975, and 11 were attacked in 1976. This characteristic frequent reinfestation was readily visible throughout the area. We found it impossible at the Pagosa Springs site to locate trees that had escaped infestation for more than 2 successive years that could serve as checks for height growth.

Effect of attack on the leaders, and leader replacement by uninfested laterals, are also illustrated in figure 3. Of the 20 leaders infested in 1974, 11 were outgrown the same year, and by 1976 the original (infested) leader retained dominance in only four instances. Meanwhile additional dominance shifts continued to occur.

The main long-term result of this kind of situation is reduced height growth. Depending on management objectives this may or may not be important; however, under intensive management rapid height growth is generally considered desirable. Also estimates of site quality determined by calculating age-height relationships of dominant trees will be reduced in stands having persistent *Eucosma* infestation.

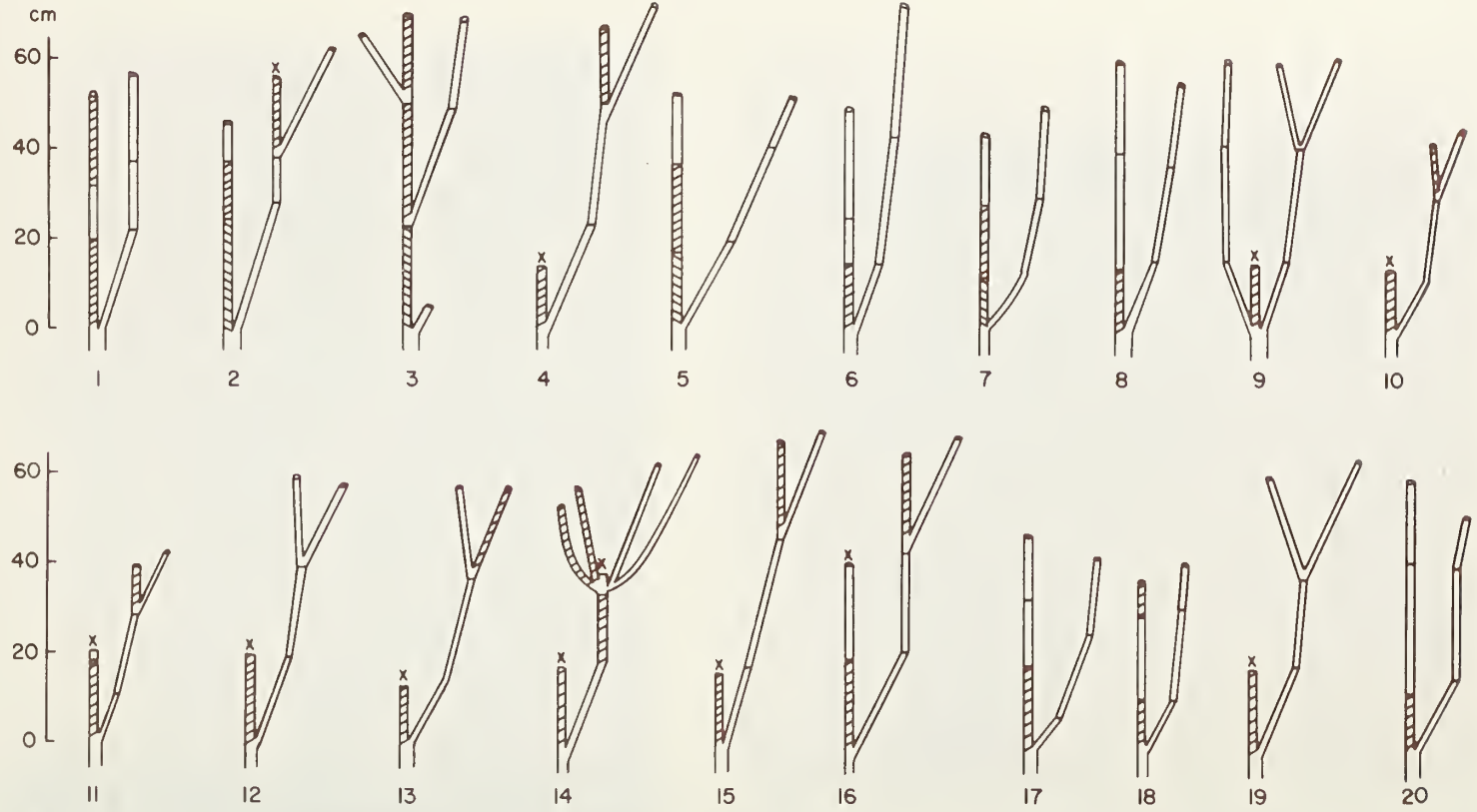

Figure 3.—Leaders and longest laterals of 20 typical infested ponderosa pine saplings at Pagosa Springs, Colorado, 1974-1976 growth. Infested shoots are shaded; dead leaders are marked with X.

Identification of Damage

In the Southwest, the long-term effects of damage caused by the shoot borer—crooks, forks, and multiple leaders—can be confused with those caused by the closely related southwestern pine tip moth, *Rhyacionia neomexicana* (Dyar). However, on close inspection they are not so hard to separate, particularly after larval feeding is completed. The tip moth mines out most of the xylem and phloem within the shoot (Jennings 1975), which then dries and eventually breaks off. In tip moth feeding the bud is almost always destroyed, and a new leader develops from one of the existing laterals. Larvae of the shoot borer, on the other hand, mine only in the pith; the leader remains green for at least another year (even if the bud dies), and the leader sometimes maintains dominance. Figure 4 illustrates the interior of infested and uninfested shoots; figure 4b shows the tightly-packed, dark brown frass left by a successful shoot borer larva. Note that the shoot borer feeding damage is confined to the pith region; the xylem and phloem are not involved as they are in the case of tip moth. Less successful larvae leave less frass, but the frass is always confined to the pith. When an infested shoot continues to live the frass in the pith area remains, providing a long-term indicator of the insects' activity. With time, however, the frass becomes increasingly suffused with resin and is often hard to distinguish from healthy pith. The following key summarizes ways to separate active or recent shoot borer activity from that of the tip moth in young trees.

	Shoot Borer *(Eucosma)*	**Tip Moth** *(Rhyacionia)*
Location of Damage	Usually terminal only; laterals rarely	Terminal and laterals
External Symptoms		
Shoot	Thickened; remains sturdy and erect	Not thickened; dries and becomes brittle, often breaks off
Needles	"Shaving-brush" appearance; shortened, usually remain green	Greatly shortened; rapidly turn yellow, then brown
Internal Symptoms	Pith mined, tightly packed with frass; xylem and phloem not damaged	Pith generally intact, xylem and phloem destroyed; large amounts of coarse, loosely packed frass in shoot

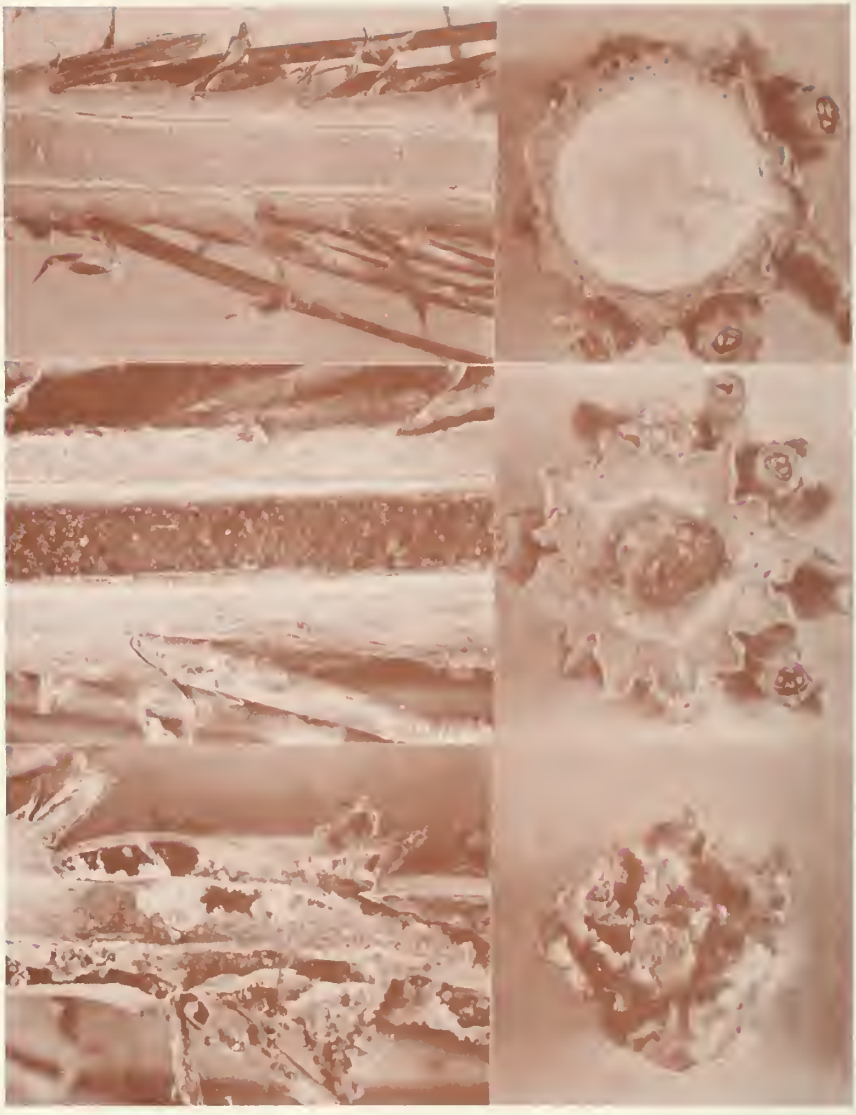

Figure 4.—Longitudinal and cross sections of (top) normal ponderosa pine leader and leaders infested with (middle) western pine-shoot borer or (lower) southwestern pine tip moth.

Shoot borers and tip moths can both infest the same shoot. We noted this particularly at the Arizona site, where some young, open-growing trees in plantations heavily infested with tip moths were also colonized by *Eucosma*.

Possibilities for Minimizing Shoot Borer Impact

Currently, no practical suppression measures for the shoot borer are known. Considering the shoot borer's life history and habits, primarily the fact that it is deep in tree tissue or in a cocoon much of its life, ordinary control methods are not effective. Recent efforts with systemic insecticides have not been encouraging. However, research to develop methods is underway, and some approaches remain to be tried.

Thinning would not appear to be helpful; in fact, Grant (1958) felt that open-grown stands were most susceptible to *E. sonomana* infesting lodgepole pine (*P. contorta* Engl.) in British Columbia. We have no information about incidence of attack as related to stand density in southwestern ponderosa pine, but close spacing certainly does not seem to be advantageous. Clipping and destroying infested shoots might be a possibility in some instances, but these shoots are very difficult to distinguish during the short period they are occupied by the larvae. Moth invasion from adjacent untreated areas could be a problem with this approach.

Developing stands having a mixture of species, e.g., ponderosa pine and Douglas-fir, might be useful; however, planting mixed stands is not generally done and would represent a radical departure from standard procedures.

Two other unconventional approaches may offer promise. The relatively low population densities characteristic of *E. sonomana* (i.e., one or only a few insects per infested tree) make it a possible candidate for suppression using attractants. Male moths can be lured to sticky traps baited with virgin females, and also to certain synthetic attractant pheromones. Work is currently underway on the West Coast to test several of these synthetic materials for suppression purposes.

In view of the insect's habit of overwintering in, or in the vicinity of, the litter, it has been suggested that controlled burning might give some measure of suppression. Controlled burning has not been tried, and may have some serious drawbacks. For example, would a useful percentage of overwintering insects be killed, and what damage would the trees sustain from the treatment? Also, possible invasions from adjacent untreated areas might pose problems.

For the time being it would seem prudent for managers in the Rocky Mountains and the Southwest — if they have alternatives — to concentrate silvicultural efforts such as planting and thinning in locations other than where *E. sonomana* is a known pest. There may be extensive areas where the species does not exist in densities high enough to cause problems. More surveys to determine its occurrence and impact are needed.

Literature Cited

Grant, J. 1958. Observations on a pine shoot moth, *Eucosma sonomana* Kft. (Lepidoptera:Olethreutidae). Proc. Ent. Soc. B. C. 55:26-27.

Jennings, Daniel T. 1975. Life history and habits of the southwestern pine tip moth, *Rhyacionia neomexicana* (Dyar) (Lepidoptera:Olethreutidae). Ann. Ent. Soc. Am. 68(3):596-606.

Stoszek, Karel J. 1973. Damage to ponderosa pine plantations by the western pine-shoot borer. J. For. 71(11):701-705.

Stevens, Robert E., and Daniel T. Jennings. 1977. Western pine-shoot borer: A threat to intensive management of ponderosa pine in the Rocky Mountain area and the Southwest. USDA For. Serv. Gen. Tech. Rep. RM-45, 8 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo. 80521.

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Keywords: Olethreutidae, *Eucosma sonomana, Rhyacionia neomexicana, Pinus ponderosa.*

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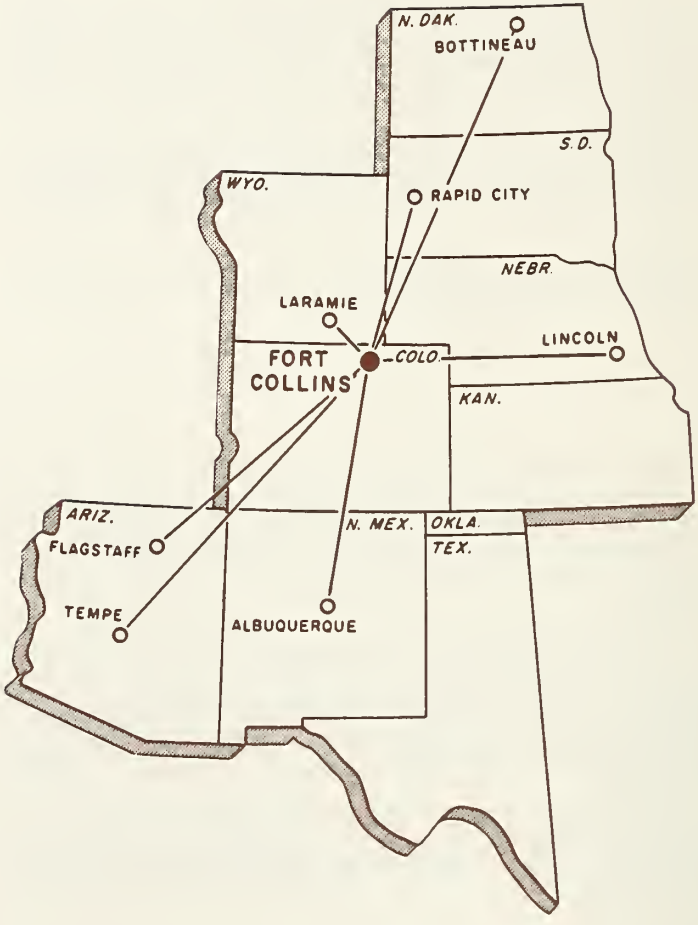
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